SEQUENCE LISTING

Sheen, Jen
Kovtun, Yelena
Chiu, Wan-Ling

<120>   Transgenic Plants Expressing a MAPKKK Protein Kinase Domain

<130>   00786/366003

<140>   10/643,434
<141>   2003-08-19

<150>   09/371,338
<151>   1999-08-10

<150>   60/095,938
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Asn Gln Glu Asn Gln Pro Pro Phe Pro Gly Val Leu Ala Asp Lys Ile
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Thr Ser Cys Ile Arg Lys Ser Lys Ile Phe Ile Lys Pro Ser Phe Ser
        35                  40                  45
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Pro Pro Pro Pro Ala Asn Thr Val Asp Met Ala Pro Pro Ile Ser Trp
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Arg Lys Gly Gln Leu Ile Gly Arg Gly Ala Phe Gly Thr Val Tyr Met
65              70              75              80

Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala Val Lys Gln Val Leu
            85              90              95

Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr Gln Ala His Ile Gln
            100             105             110

Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn Leu Ser His Pro Asn
            115             120             125

Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp Asp Thr Leu Asn Ile
    130             135             140

Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser Ser Leu Leu Glu Lys
145             150             155             160

Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr Tyr Thr Arg Gln Leu
            165             170             175

Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala Ile Met His Arg Asp
            180             185             190

Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly Cys Ile Lys Leu
            195             200             205

Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu Leu Ala Thr Met Thr
    210             215             220

Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val
225             230             235             240

Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly
            245             250             255

Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala Pro Trp Ser Gln Gln
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Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly Thr Thr Lys Ser His
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3

Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala Lys Asp Phe Leu Leu
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Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro Thr Ala Ser Glu Leu
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Leu Lys His Pro Phe Val Met Gly Lys His Lys Glu Ser Ala Ser Thr
                325   330   335

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            340   345   350

Ile Asn Asn Thr Lys Ser Thr Pro Asp Ser Thr Cys Asp Asp Val Gly
        355   360   365

Asp Met Cys Asn Phe Gly Ser Leu Asn Tyr Ser Leu Val Asp Pro Val
    370   375   380

Lys Ser Ile Gln Asn Lys Asn Leu Trp Gln Gln Asn Asp Asn Gly Gly
385   390   395   400

Asp Glu Asp Asp Met Cys Leu Ile Asp Asp Glu Asn Phe Leu Thr Phe
            405   410   415

Asp Gly Glu Met Ser Ser Thr Leu Glu Lys Asp Cys His Leu Lys Lys
        420   425   430

Ser Cys Asp Asp Ile Ser Asp Met Ser Ile Ala Leu Lys Ser Lys Phe
    435   440   445

Asp Glu Ser Pro Gly Asn Gly Glu Lys Glu Ser Thr Met Ser Met Glu
    450   455   460

Cys Asp Gln Pro Ser Tyr Ser Glu Asp Asp Glu Leu Thr Glu Ser
465   470   475   480

Lys Ile Lys Ala Phe Leu Asp Glu Lys Ala Ala Asp Leu Lys Lys Leu
            485   490   495

Gln Thr Pro Leu Tyr Glu Glu Phe Tyr Asn Ser Leu Ile Thr Phe Ser
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545                 550                 555                 560

Ser Lys Ser Pro Gly Ser Gly Gly Ser Arg Glu Leu Asn Ile Asn Asn
                565                 570                 575

Gly Gly Asp Glu Ala Ser Gln Asp Gly Val Ser Ala Arg Val Thr Asp
            580                 585                 590

Trp Arg Gly Leu Val Val Asp Thr Lys Gln Glu Leu Ser Gln Cys Val
    595                 600                 605

Ala Leu Ser Glu Ile Glu Lys Lys Trp Lys Glu Glu Leu Asp Gln Glu
    610                 615                 620

Leu Glu Arg Lys Arg Gln Glu Ile Met Arg Gln Ala Gly Leu Gly Ser
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gattttatc aaaccctcct ctcgcctcc tcctcctgct aacactgtag acatggcacc      180

tccgatttcg tggaggaaag gtcagttaat tggtcgcggc gcgtttggta cggtgtacat      240

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taccctgaat atccttctcg agtttgttcc cggtggatcg atatcatcgc tcttggagaa      480

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ggataataaa ggatgcatta agcttgctga ttttggtgca tccaaacaag tagctgagtt      660

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gtcaccgagt cggggccctc ttggtggttc accttcaaga gcaacagacg caactagttg     1680

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            20   25   30

Val Lys Gln Val Leu Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr
        35   40   45

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
    50   55   60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
65   70   75   80

Asp Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
            85   90   95

Ser Leu Leu Glu Lys Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr
            100   105   110

Tyr Thr Arg Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
        115   120   125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
    130   135   140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
145   150   155   160

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
            165   170   175

7

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
            180   185   190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
        195   200   205

Pro Trp Ser Gln Gln Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly
    210   215   220

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala
225   230   235   240

Lys Asp Phe Leu Leu Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro
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Thr Ala Ser Glu Leu Leu Lys His Pro Phe Val Met
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ttttgcttcc aaggaaaaga ctcaggctca tattcaggag cttgaagaag aagttaagct   180

tcttaaaaat ctctcccatc ctaatatagt tagatatttg ggtacagtga gggaagatga   240

taccctgaat atccttctcg agtttgttcc cggtggatcg atatcatcgc tcttggagaa   300

atttggacct tttcctgaat cagttgtccg gacatacaca aggcaactgc ttttagggtt   360

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tatccttcaa actggacata gcttctctgc tgacatatgg agcgtcggct gtacagttat   600

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cttcatagga acaacaaaat cacatcctcc aatacctgat actctctcct ctgatgcaaa   720

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<400> 11

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Ile Arg Lys Ser Met Val Phe Ala Lys Ser Gln Ser Pro Pro Asn Asn
        35                  40                  45


Ser Thr Val Gln Ile Lys Pro Pro Ile Arg Trp Arg Lys Gly Gln Leu
    50                  55                  60


Ile Gly Arg Gly Ala Phe Gly Thr Val Tyr Met Gly Met Asn Leu Asp
65              70                  75                  80


Ser Gly Glu Leu Leu Ala Val Lys Gln Ala Leu Ile Thr Ser Asn Cys
            85                  90                  95


Ala Ser Lys Glu Lys Thr Gln Ala His Ile Gln Glu Leu Glu Glu Glu
            100                 105                 110


Val Lys Leu Leu Lys Asn Leu Ser His Pro Asn Ile Val Arg Tyr Leu
        115                 120                 125


Gly Thr Val Arg Glu Asp Glu Thr Leu Asn Ile Leu Leu Glu Phe Val
    130                 135                 140


Pro Gly Gly Ser Ile Ser Ser Leu Leu Glu Lys Phe Gly Ala Phe Pro
145                 150                 155                 160


Glu Ser Val Val Arg Thr Tyr Thr Asn Gln Leu Leu Leu Gly Leu Glu
            165                 170                 175


Tyr Leu His Asn His Ala Ile Met His Arg Asp Ile Lys Gly Ala Asn
            180                 185                 190
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Ile Leu Val Asp Asn Gln Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala
        195   200   205

Ser Lys Gln Val Ala Glu Leu Ala Thr Ile Ser Gly Ala Lys Ser Met
    210   215   220

Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val Ile Leu Gln Thr Gly
225   230   235   240

His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly Cys Thr Val Ile Glu
                245   250   255

Met Val Thr Gly Lys Ala Pro Trp Ser Gln Gln Tyr Lys Glu Ile Ala
                260   265   270

Ala Ile Phe His Ile Gly Thr Thr Lys Ser His Pro Pro Ile Pro Asp
        275   280   285

Asn Ile Ser Ser Asp Ala Asn Asp Phe Leu Leu Lys Cys Leu Gln Gln
    290   295   300

Glu Pro Asn Leu Arg Pro Thr Ala Ser Glu Leu Leu Lys His Pro Phe
305   310   315   320

Val Thr Gly Lys Gln Lys Glu Ser Ala Ser Lys Asp Leu Thr Ser Phe
                325   330   335

Met Asp Asn Ser Cys Ser Pro Leu Pro Ser Glu Leu Thr Asn Ile Thr
                340   345   350

Ser Tyr Gln Thr Ser Thr Ser Asp Asp Val Gly Asp Ile Cys Asn Leu
        355   360   365

Gly Ser Leu Thr Cys Thr Leu Ala Phe Pro Glu Lys Ser Ile Gln Asn
    370   375   380

Asn Ser Leu Cys Leu Lys Ser Asn Asn Gly Tyr Asp Asp Asp Asp Asp
385   390   395   400

Asn Asp Met Cys Leu Ile Asp Asp Glu Asn Phe Leu Thr Tyr Asn Gly
                405   410   415

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Glu Thr Gly Pro Ser Leu Asp Asn Asn Thr Asp Ala Lys Lys Ser Cys
            420   425   430

Asp Thr Met Ser Glu Ile Ser Asp Ile Leu Lys Cys Lys Phe Asp Glu
            435   440   445

Asn Ser Gly Asn Gly Glu Thr Glu Thr Lys Val Ser Met Glu Val Asp
            450   455   460

His Pro Ser Tyr Ser Glu Asp Glu Asn Glu Leu Thr Glu Ser Lys Ile
465   470   475   480

Lys Ala Phe Leu Asp Asp Lys Ala Ala Glu Leu Lys Lys Leu Gln Thr
                485   490   495

Pro Leu Tyr Glu Glu Phe Tyr Asn Gly Met Ile Thr Cys Ser Pro Ile
            500   505   510

Cys Met Glu Ser Asn Ile Asn Asn Asn Lys Arg Glu Glu Ala Pro Arg
            515   520   525

Gly Phe Leu Lys Leu Pro Pro Lys Ser Arg Ser Pro Ser Gln Gly His
            530   535   540

Ile Gly Arg Ser Pro Ser Arg Ala Thr Asp Ala Ala Cys Cys Ser Lys
545   550   555   560

Ser Pro Glu Ser Gly Asn Ser Ser Gly Ala Pro Lys Asn Ser Asn Ala
                565   570   575

Ser Ala Gly Ala Glu Gln Glu Ser Asn Ser Gln Ser Val Ala Leu Ser
            580   585   590

Glu Ile Glu Arg Lys Trp Lys Glu Glu Leu Asp Gln Glu Leu Glu Arg
            595   600   605

Lys Arg Arg Glu Ile Thr Arg Gln Ala Gly Met Gly Ser Ser Pro Arg
            610   615   620

Asp Arg Ser Leu Ser Arg His Arg Glu Lys Ser Arg Phe Ala Ser Pro
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Gly Lys

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<212> DNA
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Val Lys Gln Ala Leu Ile Thr Ser Asn Cys Ala Ser Lys Glu Lys Thr
        35   40   45

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
    50   55   60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
65   70   75   80

Glu Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
                85   90   95

13

Ser Leu Leu Glu Lys Phe Gly Ala Phe Pro Glu Ser Val Val Arg Thr
            100   105   110

Tyr Thr Asn Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
        115   120   125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Gln
    130   135   140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
145   150   155   160

Leu Ala Thr Ile Ser Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
                165   170   175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
            180   185   190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
        195   200   205

Pro Trp Ser Gln Gln Tyr Lys Glu Ile Ala Ala Ile Phe His Ile Gly
    210   215   220

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Asn Ile Ser Ser Asp Ala
225   230   235   240

Asn Asp Phe Leu Leu Lys Cys Leu Gln Gln Glu Pro Asn Leu Arg Pro
                245   250   255

Thr Ala Ser Glu Leu Leu Lys His Pro Phe Val Thr
                260   265

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gttattcttc aaaccgggca tagcttttct gctgatattt ggagtgtagg atgcacagtg   600

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<210> 15
<211> 651
<212> PRT
<213> Arabidopsis thaliana

<400> 15

Met Gln Asp Ile Leu Gly Ser Val Arg Arg Ser Leu Val Phe Arg Ser
1   5   10   15

Ser Leu Ala Gly Asp Asp Gly Thr Ser Gly Gly Gly Leu Ser Gly Phe
            20   25   30

Val Gly Lys Ile Asn Ser Ser Ile Arg Ser Ser Arg Ile Gly Leu Phe
        35   40   45

Ser Lys Pro Pro Pro Gly Leu Pro Ala Pro Arg Lys Glu Glu Ala Pro
    50   55   60

Ser Ile Arg Trp Arg Lys Gly Glu Leu Ile Gly Cys Gly Ala Phe Gly
65   70   75   80

Arg Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala Ile
                85   90   95

Lys Gln Val Leu Ile Ala Pro Ser Ser Ala Ser Lys Glu Lys Thr Gln
            100   105   110

15

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Gly His Ile Arg Glu Leu Glu Glu Glu Val Gln Leu Leu Lys Asn Leu
        115                 120             125

Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Ser Asp
        130             135             140

Ser Leu Asn Ile Leu Met Glu Phe Val Pro Gly Gly Ser Ile Ser Ser
145                 150             155                 160

Leu Leu Glu Lys Phe Gly Ser Phe Pro Glu Pro Val Ile Ile Met Tyr
                165             170             175

Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn Asn Gly Ile
            180             185             190

Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly
        195             200             205

Cys Ile Arg Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu Leu
    210             215             220

Ala Thr Val Asn Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met
225             230             235                 240

Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile
            245             250             255

Trp Ser Val Gly Cys Thr Val Ile Glu Met Ala Thr Gly Lys Pro Pro
            260             265             270

Trp Ser Glu Gln Tyr Gln Gln Phe Ala Ala Val Leu His Ile Gly Arg
        275             280             285

Thr Lys Ala His Pro Pro Ile Pro Glu Asp Leu Ser Pro Glu Ala Lys
        290             295             300

Asp Phe Leu Met Lys Cys Leu His Lys Glu Pro Ser Leu Arg Leu Ser
305             310             315             320

Ala Thr Glu Leu Leu Gln His Pro Phe Val Thr Gly Lys Arg Gln Glu
            325             330             335
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16

Pro Tyr Pro Ala Tyr Arg Asn Ser Leu Thr Glu Cys Gly Asn Pro Ile
        340   345   350

Thr Thr Gln Gly Met Asn Val Arg Ser Ser Ile Asn Ser Leu Ile Arg
        355   360   365

Arg Ser Thr Cys Ser Gly Leu Lys Asp Val Cys Glu Leu Gly Ser Leu
    370   375   380

Arg Ser Ser Ile Ile Tyr Pro Gln Lys Ser Asn Asn Ser Gly Phe Gly
385   390   395   400

Trp Arg Asp Gly Asp Ser Asp Asp Leu Cys Gln Thr Asp Met Asp Asp
            405   410   415

Leu Cys Asn Ile Glu Ser Val Arg Asn Asn Val Leu Ser Gln Ser Thr
        420   425   430

Asp Leu Asn Lys Ser Phe Asn Pro Met Cys Asp Ser Thr Asp Asn Trp
    435   440   445

Ser Cys Lys Phe Asp Glu Ser Pro Lys Val Met Lys Ser Lys Ser Asn
    450   455   460

Leu Leu Ser Tyr Gln Ala Ser Gln Leu Gln Thr Gly Val Pro Cys Asp
465   470   475   480

Glu Glu Thr Ser Leu Thr Phe Ala Gly Gly Ser Ser Val Ala Glu Asp
            485   490   495

Asp Tyr Lys Gly Thr Glu Leu Lys Ile Lys Ser Phe Leu Asp Glu Lys
        500   505   510

Ala Gln Asp Leu Lys Arg Leu Gln Thr Pro Leu Leu Glu Glu Phe His
        515   520   525

Asn Ala Met Asn Pro Gly Ile Pro Gln Gly Ala Leu Gly Asp Thr Asn
    530   535   540

Ile Tyr Asn Leu Pro Asn Leu Pro Ser Ile Ser Lys Thr Pro Lys Arg
545   550   555   560

Leu Pro Ser Arg Arg Leu Ser Ala Ile Ser Asp Ala Met Pro Ser Pro

Leu Lys Ser Ser Lys Arg Thr Leu Asn Thr Ser Arg Val Met Gln Ser
        580   585   590

Gly Thr Glu Pro Thr Gln Val Asn Glu Ser Thr Lys Lys Gly Val Asn
        595   600   605

Asn Ser Arg Cys Phe Ser Glu Ile Arg Arg Lys Trp Glu Glu Glu Leu
    610   615   620

Tyr Glu Glu Leu Glu Arg His Arg Glu Asn Leu Arg His Ala Gly Ala
625   630   635   640

Gly Gly Lys Thr Pro Leu Ser Gly His Lys Gly
                645   650

<210> 16
<211> 2157
<212> DNA
<213> Arabidopsis thaliana

<400> 16
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gaggtcttag cggattcgtc gggaagatta actctagtat ccgtagctct cgaattgggc   180

tcttttctaa gccgcctcca gggcttcctg ctcctagaaa agaagaagcg ccgtcgattc   240

ggtggaggaa aggggaatta atcggttgcg gtgcttttgg aagagtttac atgggaatga   300

acctcgattc cggcgagctt cttgcaatta aacaggtttt aatcgctcca agcagtgctt   360

caaaggagaa gactcagggt cacatccgag agcttgagga agaagtacaa cttcttaaga   420

atctttcaca tccgaacatc gttagatact tgggtactgt aagagagagt gattcgttga   480

atattttgat ggagtttgtt cctggtggat caatatcatc tttgttggag aagtttggat   540

cttttcctga gcctgtgatt attatgtaca caaagcaact tctgcttggg ctggaatatc   600

ttcacaacaa tgggatcatg catcgagata ttaagggggc aaatattttg gtcgataaca   660

aaggttgcat cagactcgca gattttggtg cttccaagaa agttgtagag ctagctactg   720

taaatggtgc caaatctatg aaggggacgc cttattggat ggctcctgaa gtcattctcc   780

agactggtca tagcttctct gctgatatat ggagtgttgg gtgcactgtg attgagatgg   840

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ctacggggaa gcctccctgg agcgagcagt atcagcagtt tgctgctgtc cttcatattg    900

gtagaacaaa agctcatcct ccaattccag aagacctctc accagaggct aaagactttc    960

taatgaaatg cttacacaaa gaaccaagct tgagactctc tgcaaccgaa ttgcttcagc   1020

acccgtttgt cactggaaag cgccaggaac cttatccagc ttaccgtaat tctcttacgg   1080

aatgtggaaa cccaataact actcaaggaa tgaatgttcg gagttcaata aattcgttga   1140

tcaggaggtc gacatgttca ggcttgaagg atgtctgtga actgggaagc ttgaggagtt   1200

ccattatata cccacagaag tcaaataact caggatttgg ttggcgagat ggagactctg   1260

atgacctttg tcagaccgat atggatgatc tctgcaacat tgaatcagtc agaaacaatg   1320

ttttgtcaca gtccaccgat ttaaacaaga gttttaatcc catgtgtgat tccacggata   1380

actggtcttg caagtttgat gaaagcccaa aagtgatgaa aagcaaatct aacctgcttt   1440

cttaccaagc ttctcaactc caaactggag ttccatgtga tgaggaaacc agcttaacat   1500

ttgctggtgg ctcttccgtt gcagaggatg attataaagg cacagagttg aaaataaaat   1560

cattttttgga tgagaaggct caggatttga aaaggttgca gacccctctg cttgaagaat   1620

tccacaatgc tatgaatcca ggaataccc aaggtgcact tggagacacc aatatctaca   1680

atttaccaaa cttaccaagt ataagcaaga cacctaaacg acttccgagt agacgactct   1740

cagcaatcag tgatgctatg cccagcccac tcaaaagctc caaacgtaca ctgaacacaa   1800

gcagagtgat gcagtcagga actgaaccaa ctcaagtcaa cgagtcgacc aagaagggag   1860

taaataatag ccgttgtttc tcagagatac gtcggaagtg ggaagaagaa ctctatgaag   1920

agcttgagag gcatcgagag aatctgcgac acgctggtgc aggagggaag actccattat   1980

caggccacaa aggatagtga acggctaaag agaaactgta tgtttctttc ttatgtttca   2040

aaattacttc ttcgtatttt tttttgttgg tggggtaatt tcatgagcta gtatgatata   2100

tgtagatagt tcttcaacgg ttacatagta ttattattta ttattaattt aattgcc     2157
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<210> 17
<211> 268
<212> PRT
<213> Arabidopsis thaliana

<400> 17

Pro Ser Ile Arg Trp Arg Lys Gly Glu Leu Ile Gly Cys Gly Ala Phe
1   5   10   15

Gly Arg Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala

19

Ile Lys Gln Val Leu Ile Ala Pro Ser Ser Ala Ser Lys Glu Lys Thr
        35   40   45

Gln Gly His Ile Arg Glu Leu Glu Glu Glu Val Gln Leu Leu Lys Asn
        50   55   60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Ser
65   70   75   80

Asp Ser Leu Asn Ile Leu Met Glu Phe Val Pro Gly Gly Ser Ile Ser
                85   90   95

Ser Leu Leu Glu Lys Phe Gly Ser Phe Pro Glu Pro Val Ile Ile Met
            100   105   110

Tyr Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn Asn Gly
            115   120   125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
        130   135   140

Gly Cys Ile Arg Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu
145   150   155   160

Leu Ala Thr Val Asn Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
                165   170   175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
            180   185   190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Ala Thr Gly Lys Pro
            195   200   205

Pro Trp Ser Glu Gln Tyr Gln Gln Phe Ala Ala Val Leu His Ile Gly
        210   215   220

Arg Thr Lys Ala His Pro Pro Ile Pro Glu Asp Leu Ser Pro Glu Ala
225   230   235   240

Lys Asp Phe Leu Met Lys Cys Leu His Lys Glu Pro Ser Leu Arg Leu
                245   250   255

Ser Ala Thr Glu Leu Leu Gln His Pro Phe Val Thr
            260   265

<210> 18
<211> 804
<212> DNA
<213> Arabidopsis thaliana

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agcagtgctt caaaggagaa gactcagggt cacatccgag agcttgagga agaagtacaa   180

cttcttaaga atctttcaca tccgaacatc gttagatact tgggtactgt aagagagagt   240

gattcgttga atattttgat ggagtttgtt cctggtggat caatatcatc tttgttggag   300

aagtttggat cttttcctga gcctgtgatt attatgtaca caaagcaact tctgcttggg   360

ctggaatatc ttcacaacaa tgggatcatg catcgagata ttaaggggc aaatattttg   420

gtcgataaca aaggttgcat cagactcgca gattttggtg cttccaagaa agttgtagag   480

ctagctactg taaatggtgc caaatctatg aaggggacgc cttattggat ggctcctgaa   540

gtcattctcc agactggtca tagcttctct gctgatatat ggagtgttgg gtgcactgtg   600

attgagatgg ctacggggaa gcctccctgg agcgagcagt atcagcagtt tgctgctgtc   660

cttcatattg gtagaacaaa agctcatcct ccaattccag aagacctctc accagaggct   720

aaagactttc taatgaaatg cttacacaaa gaaccaagct tgagactctc tgcaaccgaa   780

ttgcttcagc acccgtttgt cact   804

<210> 19
<211> 690
<212> PRT
<213> Nicotiana tabacum

<400> 19

Met Gln Asp Phe Ile Gly Ser Val Arg Arg Ser Leu Val Phe Lys Gln
1   5   10   15

Ser Gly Asp Phe Asp Thr Gly Ala Ala Gly Val Gly Ser Gly Phe Gly
            20   25   30

Gly Phe Val Glu Lys Leu Gly Ser Ser Ile Arg Lys Ser Ser Ile Gly

21

Ile Phe Ser Lys Ala His Val Pro Ala Leu Pro Ser Ile Ser Lys Ala
    50   55   60

Glu Leu Pro Ala Lys Ala Arg Lys Asp Asp Thr Pro Pro Ile Arg Trp
65   70   75   80

Arg Lys Gly Glu Met Ile Gly Cys Gly Ala Phe Gly Arg Val Tyr Met
                85   90   95

Gly Met Asn Val Asp Ser Gly Glu Leu Leu Ala Ile Lys Glu Val Ser
            100   105   110

Ile Ala Met Asn Gly Ala Ser Arg Glu Arg Ala Gln Ala His Val Arg
        115   120   125

Glu Leu Glu Glu Glu Val Asn Leu Leu Lys Asn Leu Ser His Pro Asn
    130   135   140

Ile Val Arg Tyr Leu Gly Thr Ala Arg Glu Ala Gly Ser Leu Asn Ile
145   150   155   160

Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser Ser Leu Leu Gly Lys
            165   170   175

Phe Gly Ser Phe Pro Glu Ser Val Ile Arg Met Tyr Thr Lys Gln Leu
            180   185   190

Leu Leu Gly Leu Glu Tyr Leu His Lys Asn Gly Ile Met His Arg Asp
        195   200   205

Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly Cys Ile Lys Leu
    210   215   220

Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu Leu Ala Thr Met Thr
225   230   235   240

Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val
            245   250   255

Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly
            260   265   270

Cys Thr Ile Ile Glu Met Ala Thr Gly Lys Pro Pro Trp Ser Gln Gln
        275   280   285

Tyr Gln Glu Val Ala Ala Leu Phe His Ile Gly Thr Thr Lys Ser His
    290   295   300

Pro Pro Ile Pro Glu His Leu Ser Ala Glu Ser Lys Asp Phe Leu Leu
305   310   315   320

Lys Cys Leu Gln Lys Glu Pro His Leu Arg His Ser Ala Ser Asn Leu
                325   330   335

Leu Gln His Pro Phe Val Thr Ala Glu His Gln Glu Ala Arg Pro Phe
            340   345   350

Leu Arg Ser Ser Phe Met Gly Asn Pro Glu Asn Met Ala Ala Gln Arg
        355   360   365

Met Asp Val Arg Thr Ser Ile Ile Pro Asp Met Arg Ala Ser Cys Asn
    370   375   380

Gly Leu Lys Asp Val Cys Gly Val Ser Ala Val Arg Cys Ser Thr Val
385   390   395   400

Tyr Pro Glu Asn Ser Leu Gly Lys Glu Ser Leu Trp Lys Leu Gly Asn
                405   410   415

Ser Asp Asp Asp Met Cys Gln Met Asp Asn Asp Asp Phe Met Phe Gly
                420   425   430

Ala Ser Val Lys Cys Ser Ser Asp Leu His Ser Pro Ala Asn Tyr Lys
        435   440   445

Ser Phe Asn Pro Met Cys Glu Pro Asp Asn Asp Trp Pro Cys Lys Phe
    450   455   460

Asp Glu Ser Pro Glu Leu Thr Lys Ser Gln Ala Asn Leu His Tyr Asp
465   470   475   480

Gln Ala Thr Ile Lys Pro Thr Asn Asn Pro Ile Met Ser Tyr Lys Glu
                485   490   495

23

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Asp Leu Ala Phe Thr Phe Pro Ser Gly Gln Ser Ala Ala Glu Asp Asp
            500             505             510

Asp Glu Leu Thr Glu Ser Lys Ile Arg Ala Phe Leu Asp Glu Lys Ala
            515             520             525

Met Asp Leu Lys Lys Leu Gln Thr Pro Leu Tyr Glu Gly Phe Tyr Asn
    530             535             540

Ser Leu Asn Val Ser Ser Thr Pro Ser Pro Val Gly Thr Gly Asn Lys
545             550             555             560

Glu Asn Val Pro Ser Asn Ile Asn Leu Pro Pro Lys Ser Arg Ser Pro
            565             570             575

Lys Arg Met Leu Ser Arg Arg Leu Ser Thr Ala Ile Glu Gly Ala Cys
            580             585             590

Ala Pro Ser Pro Val Thr His Ser Lys Arg Ile Ser Asn Ile Gly Gly
    595             600             605

Leu Asn Gly Glu Ala Ile Gln Glu Ala Gln Leu Pro Arg His Asn Glu
    610             615             620

Trp Lys Asp Leu Leu Gly Ser Gln Arg Glu Ala Val Asn Ser Ser Phe
625             630             635             640

Ser Glu Arg Gln Arg Arg Trp Lys Glu Glu Leu Asp Glu Glu Leu Gln
            645             650             655

Arg Lys Arg Glu Ile Met Arg Gln Ala Val Asn Leu Ser Pro Pro Lys
            660             665             670

Asp Pro Ile Leu Asn Arg Cys Arg Ser Lys Ser Arg Phe Ala Ser Pro
    675             680             685

Gly Arg
    690


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<211>   2527
<212>   DNA
<213>   Nicotiana tabacum
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<400> 20

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cgctgccggt gtcggcagcg gattcggagg cttcgttgag aaactaggtt cgagcattcg     180

caaatcgagt attggaatct tctcgaaagc tcatgttcct gctcttccgt ctatttctaa     240

agctgagctg cccgcgaagg ctcggaaaga tgacactccg ccaatccggt ggaggaaagg     300

tgaaatgatt ggatgtggtg cttttggtag ggtttatatg gggatgaatg ttgattctgg     360

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tccttggagc cagcagtatc aggaggttgc tgctctcttc catataggga caaccaaatc     960

ccatcccccc atcccagagc atctttctgc tgaatcaaag gacttcctat taaaatgttt    1020

gcagaaggaa ccgcacctga ggcattctgc atcaaatttg cttcagcatc catttgttac    1080

agcagaacat caggaagctc gcccttttct tcgctcatcc tttatgggaa accccgaaaa    1140

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gaattcctta gggaaagagt cactctggaa actaggaaac tctgatgatg acatgtgcca    1320

gatggataat gatgatttta tgtttggtgc atctgtgaaa tgcagttcag atttgcattc    1380

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tattaagccc actaataacc ccatcatgtc atacaaggag gatcttgctt tcacatttcc    1560

aagtgggcaa tctgcagccg aggatgatga tgaattgaca gagtctaaaa ttagggcatt    1620

ccttgatgaa aaggcaatgg acttgaagaa gctgcaaaca ccactatatg aaggattcta    1680
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25

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atcaaatatt ggtggcctaa atggtgaagc tattcaggaa gctcagttgc cgaggcataa    1920

tgaatggaaa gatcttcttg gttctcaacg tgaagcagtt aattcaagct ctctgagag    1980

gcaaagaagg tggaaagaag agcttgatga agagttgcaa aggaaacgag agattatgcg    2040

tcaggcagtc aacttatcac caccaaagga tccaattcta aatcgatgta gaagtaaatc    2100

aaggtttgca tctcctggaa gataaatgta tgtacttgtg tccctaaact aaagtcagtt    2160

tgaagaatat aattaatgat cctgcaaccc agaacagag agttagatgt cttgagcagg    2220

tatacgaacg tgaggttttc ttgacccgtt actacaggaa tatcagcgct tgtcagatag    2280

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ttttataacc tatataagtg ctctctcatg gtagttgcca atattaaaac gcagagaaaa    2460

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tacaacc                                                            2527


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<212>  PRT
<213>  Nicotiana tabacum

<400>  21

Pro Pro Ile Arg Trp Arg Lys Gly Glu Met Ile Gly Cys Gly Ala Phe
1               5                   10                  15


Gly Arg Val Tyr Met Gly Met Asn Val Asp Ser Gly Glu Leu Leu Ala
            20                  25                  30


Ile Lys Glu Val Ser Ile Ala Met Asn Gly Ala Ser Arg Glu Arg Ala
        35                  40                  45


Gln Ala His Val Arg Glu Leu Glu Glu Glu Val Asn Leu Leu Lys Asn
    50                  55                  60


Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Ala Arg Glu Ala
65                  70                  75                  80
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26

Gly Ser Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
                85   90   95

Ser Leu Leu Gly Lys Phe Gly Ser Phe Pro Glu Ser Val Ile Arg Met
            100   105   110

Tyr Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Lys Asn Gly
            115   120   125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
    130   135   140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu
145   150   155   160

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
                165   170   175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
            180   185   190

Ile Trp Ser Val Gly Cys Thr Ile Ile Glu Met Ala Thr Gly Lys Pro
        195   200   205

Pro Trp Ser Gln Gln Tyr Gln Glu Val Ala Ala Leu Phe His Ile Gly
    210   215   220

Thr Thr Lys Ser His Pro Pro Ile Pro Glu His Leu Ser Ala Glu Ser
225   230   235   240

Lys Asp Phe Leu Leu Lys Cys Leu Gln Lys Glu Pro His Leu Arg His
                245   250   255

Ser Ala Ser Asn Leu Leu Gln His Pro Phe Val Thr
                260   265

<210> 22
<211> 804
<212> DNA
<213> Nicotiana Tabacum

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aatggtgctt cgagagagcg agcacaagct catgttagag agcttgagga agaagtgaat 180

ctattgaaga atctctccca tcccaacata gtgagatatt tgggaactgc aagagaggca 240

ggatcattaa atatattgtt ggaatttgtt cctggtggct caatctcgtc acttttggga 300

aaatttggat ccttccctga atctgttata agaatgtaca ccaagcaatt gttattaggg 360

ttggaatact tgcataagaa tgggattatg cacagagata ttaagggagc aaacatactt 420

gttgacaata aaggttgcat taaacttgct gatttcggtg catccaagaa ggttgttgaa 480

ttggctacta tgactggtgc caagtcaatg aagggtactc catactggat ggctcccgaa 540

gtcattctgc agactggcca tagcttctct gctgacatat ggagtgtcgg atgcactatt 600

atcgaaatgg ctacaggaaa acctccttgg agccagcagt atcaggaggt tgctgctctc 660

ttccatatag ggacaaccaa atcccatccc cccatcccag agcatctttc tgctgaatca 720

aaggacttcc tattaaaatg tttgcagaag gaaccgcacc tgaggcattc tgcatcaaat 780

ttgcttcagc atccatttgt taca 804

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<211> 666
<212> PRT
<213> Arabidopsis thaliana

<400> 23

Met Gln Asp Phe Phe Gly Ser Val Arg Arg Ser Leu Val Phe Arg Pro
1   5   10   15

Ser Ser Asp Asp Asp Asn Gln Glu Asn Gln Pro Pro Phe Pro Gly Val
            20   25   30

Leu Ala Asp Lys Ile Thr Ser Cys Ile Arg Lys Ser Lys Ile Phe Ile
        35   40   45

Lys Pro Ser Phe Ser Pro Pro Pro Ala Asn Thr Val Asp Met Ala
    50   55   60

Pro Pro Ile Ser Trp Arg Lys Gly Gln Leu Ile Gly Arg Gly Ala Phe
65   70   75   80

Gly Thr Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala
                85   90   95

28

Val Lys Gln Val Leu Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr
            100   105   110

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
            115   120   125

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
        130   135   140

Asp Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
145   150   155   160

Ser Leu Leu Glu Lys Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr
                165   170   175

Tyr Thr Arg Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
            180   185   190

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
            195   200   205

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
    210   215   220

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
225   230   235   240

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
                245   250   255

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
            260   265   270

Pro Trp Ser Gln Gln Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly
        275   280   285

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala
    290   295   300

Lys Asp Phe Leu Leu Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro
305   310   315   320

Thr Ala Ser Glu Leu Leu Lys His Pro Phe Val Met Gly Lys His Lys
            325   330   335

Glu Ser Ala Ser Thr Asp Leu Gly Ser Val Leu Asn Asn Leu Ser Thr
            340   345   350

Pro Leu Pro Leu Gln Ile Asn Asn Thr Lys Ser Thr Pro Asp Ser Thr
            355   360   365

Cys Asp Asp Val Gly Asp Met Cys Asn Phe Gly Ser Leu Asn Tyr Ser
    370   375   380

Leu Val Asp Pro Val Lys Ser Ile Gln Asn Lys Asn Leu Trp Gln Gln
385   390   395   400

Asn Asp Asn Gly Gly Asp Glu Asp Asp Met Cys Leu Ile Asp Asp Glu
            405   410   415

Asn Phe Leu Thr Phe Asp Gly Glu Met Ser Ser Thr Leu Glu Lys Asp
            420   425   430

Cys His Leu Lys Lys Ser Cys Asp Asp Ile Ser Asp Met Ser Ile Ala
        435   440   445

Leu Lys Ser Lys Phe Asp Glu Ser Pro Gly Asn Gly Glu Lys Glu Ser
        450   455   460

Thr Met Ser Met Glu Cys Asp Gln Pro Ser Tyr Ser Glu Asp Asp Asp
465   470   475   480

Glu Leu Thr Glu Ser Lys Ile Lys Ala Phe Leu Asp Glu Lys Ala Ala
            485   490   495

Asp Leu Lys Lys Leu Gln Thr Pro Leu Tyr Glu Glu Phe Tyr Asn Ser
        500   505   510

Leu Ile Thr Phe Ser Pro Ser Cys Met Glu Ser Asn Leu Ser Asn Ser
        515   520   525

Lys Arg Glu Asp Thr Ala Arg Gly Phe Leu Lys Leu Pro Pro Lys Ser
    530   535   540

30

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Arg Ser Pro Ser Arg Gly Pro Leu Gly Gly Ser Pro Ser Arg Ala Thr
545                 550                 555                 560


Asp Ala Thr Ser Cys Ser Lys Ser Pro Gly Ser Gly Gly Ser Arg Glu
                565                 570                 575


Leu Asn Ile Asn Asn Gly Gly Asp Glu Ala Ser Gln Asp Gly Val Ser
            580                 585                 590


Ala Arg Val Thr Asp Trp Arg Gly Leu Val Val Asp Thr Lys Gln Glu
        595                 600                 605


Leu Ser Gln Cys Val Ala Leu Ser Glu Ile Glu Lys Lys Trp Lys Glu
    610                 615                 620


Glu Leu Asp Gln Glu Leu Glu Arg Lys Arg Gln Glu Ile Met Arg Gln
625                 630                 635                 640


Ala Gly Leu Gly Ser Ser Pro Arg Asp Arg Gly Met Ser Arg Gln Arg
            645                 650                 655


Glu Lys Ser Arg Phe Ala Ser Pro Gly Lys
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Met Met Arg Ile Ser
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